

Remarks

The Office Action dated May 5, 2008, has been received and the following remarks form a full and complete response thereto. Claims 31-57 are pending in this application. Consideration of the application is respectfully requested in view of the following remarks.

Claims 31-34 and 39-43 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,616,067 to Goenka ("Goenka"). Applicant traverses the rejection on the basis that claims 31-34 and 39-43 recite subject matter neither disclosed nor suggested by Goenka.

Claim 31, upon which claims 32-34 and 39-43 depend, recites a blasting method for cleaning surfaces. According to the method, liquid CO₂ is supplied via a feed line into an expansion volume, which has an enlarged cross section. The liquid CO₂, which is fed under pressure with a carrier gas to a blasting nozzle, is transformed into dry snow by expansion in the expansion volume. The volume V of the expansion volume and the internal cross sectional area A of the feed line have the relation $V^{1/3} / A^{1/2} > 3$. The mixture of carrier gas and dry snow is accelerated in the blasting nozzle at at least approximately sonic speed. The carrier gas is supplied under pressure through a blasting line to the blasting nozzle where the liquid CO₂ is transformed into dry snow in the expansion volume apart from the carrier gas in the blasting line and the dry snow is introduced from the expansion volume into the blasting line upstream of the blasting nozzle.

Goenka relates to an apparatus and method for creating abrasive CO₂ particles and for directing the resulting CO₂ particle onto a large area of contaminants to be removed from a pressure sensitive work piece. See Goenka at col. 1, lines 6-10. Goenka discloses a nozzle 60 comprising a tapering section into which the shop air enters via feed line 11 and a diverging section 30. See Goenka at Col. 3, lines 4-31; Fig. 1. Liquid CO₂ is expelled through orifices 26a-d and the resulting solid particles are carried by the shop air toward the diverging section 30. *Id.* Liquid CO₂ can pass through CO₂ channels 124 and out CO₂ orifices into the converging/diverging nozzle, where it becomes CO₂ particles. See Goenka at col. 6, lines 21-37; Fig. 5. Goenka, however, fails to disclose or suggest introducing dry snow from the expansion volume into the blasting line upstream of the blasting nozzle, as required by claim 31.

The Office Action alleges that Goenka discloses this claim feature, however, it does not. Instead, Goenka discloses introducing liquid CO₂ directly into the throat of the nozzle 160 downstream of the throat section 120. Indeed, Goenka fails to teach or suggest an expansion volume at all; liquid CO₂ is introduced directly into the nozzle instead of being converted to dry snow in an expansion volume before being introduced into the carrier gas in the blasting line upstream of the blasting nozzle, as claim 31 requires. Accordingly, Goenka fails to disclose or suggest each and every element of claim 31. The Applicant, therefore, respectfully requests the withdrawal of the rejection of claim 31 and its dependent claims 32-34 and 39-43.

Claims 35 and 36 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Goenka in view of U.S. Patent No. 5,184,427 to Armstrong (“Armstrong”). Applicant traverses the rejection on the basis that claims 35 and 36 recite subject matter neither disclosed nor suggested by the combination of Goenka and Armstrong. Claims 35 and 36, for instance, are patentable over Goenka for at least the same reasons stated above with respect to claim 31, from which they depend. Armstrong, which is cited for its disclosure of a blast cleaning system in which various parts are insulated to maintain the required temperatures (see Office Action at 3) fails to remedy the deficiencies of Goenka. Applicant, therefore, respectfully requests the withdrawal of the rejection of claims 35 and 36.

Claim 37 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Goenka in view of U.S. Patent No. 5,785,581 to Settles (“Settles”). Applicant traverses on the basis that claim 37 recites subject matter neither disclosed nor suggested by the combination of Goenka and Settles. For instance, claim 37 is patentable over Goenka for at least the same reasons stated above with respect to claim 31, from which claim 37 depends. Furthermore, Settles, which the Office Action cites for its disclosure of swirl edges to aid in the atomization of fluids (see Office Action at 3), fails to remedy the deficiencies of Goenka. Applicant, therefore, respectfully requests the withdrawal of the rejection of claim 37.

Claims 44-57 were rejected under 35 U.S.C. §103(a) as unpatentable over Goenka in view of Settles. Applicant traverses the rejection on the basis that claims 44-57 recite subject matter neither disclosed nor suggested by the combination of Goenka and Settles.

Independent claim 44, upon which claims 45-57 depend, recites an apparatus for cleaning surfaces. The apparatus has an expansion volume with a volume V , a feed line with an internal cross-sectional area A for supplying liquid CO_2 . The feed line opens into the expansion volume and the ratio of the internal cross-sectional area A of the feed line to the volume V of the expansion volume is $V^{1/3}/A^{1/2} > 3$. The apparatus additionally comprises a convergent/divergent blasting nozzle for discharging a mixture of a carrier gas and CO_2 in the form of dry snow. A blasting line is provided for supplying the carrier gas under pressure. The expansion volume opens onto the blasting line and is located between the feed line and the blasting line such that the liquid CO_2 is transformed into dry snow in the expansion volume apart from the carrier gas in the blasting line. The blasting nozzle is connected to the downstream end of the blasting line.

As a result of the claimed configuration, claim 44 requires an expansion volume upstream of the blasting line, which is upstream of the blast nozzle such that the liquid CO_2 is transformed into dry snow in the expansion volume apart from the carrier gas in the blasting line. As discussed above with respect to claim 31, Goenka fails to disclose

or suggest an expansion volume at all let alone an expansion volume opening onto the blasting line located between the feed line and the blasting line such that the liquid CO₂ is transformed into dry snow in the expansion volume apart from the carrier gas in the blasting line. Instead, Goenka discloses converting liquid CO₂ into particles directly in the nozzle. See Goenka at col. 6, lines 21-32; Figs. 1 and 5. As Goenka fails to disclose or suggest an expansion volume positioned upstream of the blast line, as required by claim 44, claim 44 is patentable over Goenka. Settles fails to remedy the deficiencies of Goenka.

Settles, which the Office Action cites for its disclosure of a convergent/divergent nozzle (see Office Action at 3-4), relates to a device and method for abrasive cleaning of surfaces by the production of ice crystals projected onto those surfaces. See Settles at col. 1, lines 9-11. Like Goenka, however, Settles fails to disclose an expansion volume as recited by claim 44. Accordingly, Settles fails to remedy the deficiencies of Goenka with respect to claim 44. Thus, the combination of Goenka and Settles fails to disclose or suggest each and every element of claim 44. Applicant, therefore, respectfully requests the withdrawal of the rejection of claim 44 and its dependent claims 45-57.

Claim 38 was rejected under 35 U.S.C. § 103(a) as allegedly unpatentable over Goenka. Applicant traverses the rejection on the basis that claim 38 recites subject matter neither disclosed nor suggested by Goenka.

Claim 38 recites a blasting method for cleaning surfaces wherein liquid CO₂ is supplied via a feed line into an expansion volume having an enlarged cross section.

Inside of the expansion volume, the CO₂ is transformed into dry snow by expansion, and is fed under pressure, together with a carrier gas to a blasting nozzle. The volume V of the expansion volume and the internal cross-section area A of the feed line fulfill the relation $V^{1/3} / A^{1/2} > 3$, and the mixture of carrier gas and dry snow is accelerated into the blasting nozzle to at least sonic speed. The carrier gas is supplied under pressure through the blasting line to the blasting nozzle, and the liquid CO₂ is introduced from the expansion volume into the blasting line upstream of the blasting nozzle. The blasting nozzle has a constriction, a mixture of gaseous, liquid and solid CO₂ is produced in the expansion volume, and a part of the solid and liquid components evaporate in the blasting line or the blasting nozzle. The position of the evaporation zone relative to the constriction is determined by regulating the flow of carrier gas.

As stated above with respect to claim 31, Goenka fails to disclose or suggest an expansion volume at all let alone an expansion volume inside of which CO₂ is transformed into dry snow by expansion, and is fed under pressure, together with a carrier gas to a blasting nozzle, as claim 38 requires. Accordingly, Goenka fails to disclose or suggest each and every element of claim 38. Applicant, therefore, respectfully requests withdrawal of the rejection of claim 38.

In view of the above, all rejections have been sufficiently addressed. Applicants submit that the application is now in condition for allowance and request that claims 1 - 19 be allowed and this application passed to issue.

In the event that this paper is not timely filed, the Applicant respectfully petitions for an appropriate extension of time. Any fees for such an extension together with any additional fees may be charged to Counsel's Deposit Account No. 02-2135.

If for any reason the Examiner determines that the application is not now in condition for allowance, it is respectfully requested that the Examiner contact, by telephone, the Applicant's undersigned attorney at the indicated telephone number to arrange for an interview to expedite the disposition of this application.

Respectfully submitted,

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